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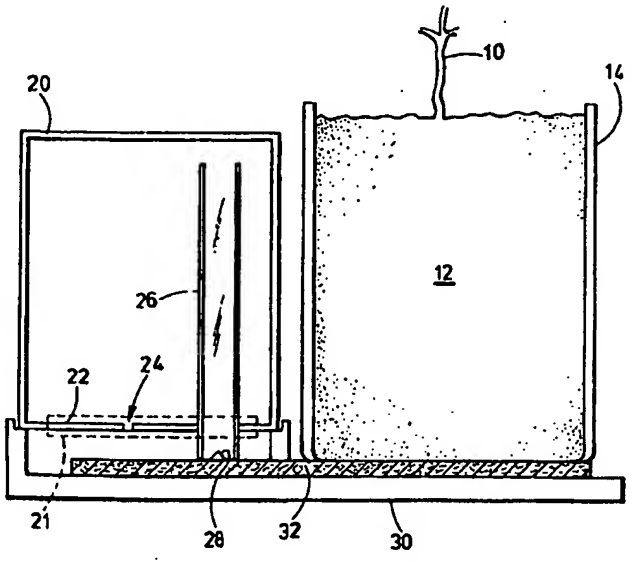

(57) Abstract

A device for automatically watering household plants. A sealed reservoir (20) is used to supply the growing medium (12) in a pot (14) with water via a capillary mat (32). There is small water outlet aperture (24) in the base (22) in the reservoir (20). An air inlet tube (26) extends up through the base to near the top of the reservoir, which allows air into the reservoir. The bottom end of the tube (26) stands on the mat (32) so that an air inlet notch (28) periodically becomes sealed by water held in the mat (28), which stops the water flow through the water outlet (24). As the plant (10) takes water the mat dries out and eventually the seal at the air inlet will be broken, allowing water to flow from the reservoir once more.

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SELF-REGULATING SYSTEM FOR WATERING PLANTS

The present invention relates in particular, but not exclusively, to self-regulating watering apparatus for potted plants.

Most plants need a regular supply of water for healthy growth. To maintain the plant in a healthy state, watering must be carried out with a frequency and in a quantity to maintain the plant's growing medium correctly moist. The rate at which water must be supplied is dependent upon a number of factors including the type and size of plant, the time of year, and environmental conditions. A sudden change in environmental conditions could lead to over- or underwatering. Should watering be forgotten, the growing medium could dry out causing death of the plant.

There is, therefore, a demand for a device which can be entrusted to water a plant automatically, and various such devices have been proposed. However, known devices do not provide for adjustment of the rate of water supplied to the plant to compensate for the varying water requirements of different types of plant, nor do they provide compensation in their water supply to keep the growing medium, as far as possible, in a constant degree of dampness.

It is the aim of the present invention to provide self-regulating apparatus for watering plants which provides a supply of water to a plant in a controlled manner favourable for growth of the plant.

According to the present invention, there is provided a self-regulating system, for watering a plant

growing in a growing medium, in which water-supplying means comprising a reservoir is arranged to deliver water to the growing medium under the control of controlling means which is responsive to the wetness of the growing medium, the controlling means being arranged to regulate the dispensing of water from the reservoir by controlling the admission of pressure-balancing air into the reservoir through the use of an air inlet which is arranged to become sealed in a wet condition of the medium.

The controlling means may be responsive to the wetness of the growing medium by direct or indirect sensing. That is to say, the air inlet may be immersed in (or at least in contact with) the growing medium itself, or it may be arranged to sense the wetness of the growing medium through immersion in (or contact with) some water-transporting body or material which itself is in communication with the growing medium. For example, the air inlet may engage water-absorbent material (e.g. compost or capillary matting) which extends into contact with the growing medium.

In another of its aspects the invention provides self-regulating apparatus for watering a plant growing in a growing medium comprising water-supplying means arranged to supply water to a water outlet, water-transporting means arranged to receive water supplied from the water outlet and to extend into contact with the growing medium, whereby water can be taken up from the transporting means by absorption by the growing medium, and controlling means which is responsive to the amount of water present in the transporting means to regulate the dispensing of water through the water outlet.

The water-supplying means may comprise a reservoir and the dispensing of water through the water outlet may be regulated by controlling the admission of pressure-balancing air into the reservoir. To this end, the controlling means may comprise means forming an air inlet which is arranged to become sealed by water collecting in the transporting means. In a convenient arrangement, the transporting means comprises a mat of water-absorbent material against which an air inlet leading to the interior of the reservoir becomes sealed in a wet condition of the mat; balancing air is permitted to enter the reservoir through the inlet in a dry condition of the mat. The air inlet may be provided by an opening formed between a bottom end portion of an inlet duct and the mat, the duct leading into the reservoir and sealing at its bottom end against the mat in the wet condition of the mat. The duct may communicate with the interior of the reservoir at a level above the normal level of water within the reservoir, though a duct discharging at a lower level can be utilised. Most conveniently, the inlet duct is in the form of an upright tube which extends upwards from the mat and through a base of the reservoir into the interior of the reservoir. The air inlet opening may be in the form of a notch which extends from a generally annular end face of the duct which abuts the mat.

The water-transporting means, conveying water dispensed from the water outlet to the growing medium in which a plant is rooted, may take any suitable form. As well as capillary matting, it may comprise other water-absorbent material and may comprise, for example, compost or other material which might itself provide a growing medium.

The controlling means compensates for conditions where more or less water must be supplied to the growing medium. For example, it increases the flow when the growing medium is being dried by ambient heat or wind.

Preferably, the flow of water from the water outlet is controlled to provide a sufficient supply of water to the transport means to allow the control means to provide sufficient water to the growing medium, without allowing excess water to leave the reservoir.

Embodiments of the invention will now be described in detail by way of example with reference to the accompanying drawings, in which:-

Figure 1 shows schematically a first embodiment of the invention;

Figures 2 and 3 show in detail an air inlet adjustment arrangement;

Figures 4A and 4B illustrate a second embodiment of the invention;

Figure 5 shows a third embodiment of the invention;

Figure 6 shows a propagator embodying the invention;

Figure 7 shows possible modifications to the propagator of Figure 6;

Figure 8 illustrates a further embodiment of the invention; and

Figure 9 illustrates a still further embodiment of the invention.

With reference to Figure 1, apparatus is provided for watering a plant 10 growing in a growing medium 12 within a pot 14.

The apparatus comprises a water reservoir 20, having a box structure which forms a generally sealed container. The reservoir 20 has a base 22, through which there is provided a water outlet aperture 24. An air inlet duct in the form of an elongate tube of circular section 26 also extends through the base 22, a seal being formed between the base 22 and the periphery of the tube 26. The tube 26 has an open top end within the reservoir 20 remote from the base 22 and an open bottom end externally of the reservoir 20. At the bottom end, the tube 26 has an annular, transverse end face. An air inlet notch 28 is provided, extending axially a short distance into the tube from the end face.

In an alternative construction, the base 22 may have an aperture in which a bung 21 is sealingly and removably inserted, the bung 21 carrying the tube 26 and through which the water outlet aperture extends.

The reservoir 20 and the plant pot 14 are carried on a base unit 30. The base unit 30 also carries a capillary mat 32 on a part of which the pot 14 is supported, the pot 14 having apertures in its base through which the growing medium 12 makes contact with the mat 32. The mat 32 extends from the pot 14 to pass under the reservoir 20 which is supported a short distance above the mat 32 such that the bottom end face of the tube 26 is touching the mat 32 and substantially

parallel therewith. Water-transporting means, comprising the capillary mat 32, is so provided to convey water from the reservoir to the growing medium 12 in the pot.

The reservoir 20 is carried by the base unit 30 such that it may easily be removed therefrom.

In use, the reservoir 20 is first removed from the base unit 30 and inverted such that the base 22 is uppermost. The reservoir 20 is then filled with water through the tube 26 (or by removing the bung 21, as the case may be). The reservoir 20 is then once again inverted and lowered into place on the base unit 30.

Immediately, any water in the tube 26 will be spilled out onto the mat 32 (which, it is assumed, is initially dry) and will be absorbed. Also, water will drain onto the mat 32 through the water outlet 24. While the mat 32 in a region proximal to the tube 26 is dry, air may enter the bottom end of the tube 26 to replace in the reservoir 20 the volume of water draining from the reservoir 20. Eventually, when the mat 32 becomes saturated, the bottom end of the tube 26 (including the air inlet notch 28) becomes sealed against ingress of air. Thus, as water continues to flow from the reservoir 20 through the aperture 24, pressure in the reservoir decreases. This has two effects: firstly, water from the mat 32 is pushed upwardly within the tube 26 by ambient pressure; and secondly, flow from the water outlet aperture eventually ceases, being prevented by ambient pressure once the air pressure in the reservoir 20 drops below a threshold level.

From the above, it will be appreciated that an initially dry mat 32 is quickly wettened to supply water to the plant 10 as quickly as possible. Then, equilibrium is reached and flow of water substantially stops.

Further to this, the growing medium 12 will take up water from the mat 32 to replace water consumed by the plant 10 and lost through evaporation. This absorbed water will initially be replaced in the mat by water previously pushed up into the tube 26, but the result of this drawing of water from the tube 26 is that the pressure within the reservoir 20 is further reduced. Eventually, the decrease in the pressure, combined with the reduction of the sealing effect due to the reduced head of water in the tube 26, and the reduction of the water content of the mat 32, causes the seal between the bottom end of the tube 26 and the mat 32 to break down at the notch 28, pressure-balancing air then entering the tube 26 through the notch 28. Air entering the tube 26 rises into the reservoir 20 causing an increase in pressure therein. Eventually, the pressure will rise to such an extent that water can once more flow out of the reservoir 20 through the water outlet aperture 24. The process of wetting of the mat 32 is thus repeated, and continues in cycles.

With reference to Figure 2, the reservoir 20 may comprise an upper part (not shown) having the general form of an inverted bucket with a peripheral flange at its opening, and a lower part 40 comprising the base 22 of the reservoir 20 and a peripheral flange 42. The lower and upper parts are sealingly interconnected by their flanges to form the complete reservoir 20.

A short tube 26' extends through the base 22 and is secured thereto or may be integral therewith. The short tube 26' constitutes a bottom end portion of the tube 26 of the apparatus which, in use, has an end face adjacent the mat 32. The short tube 26' is provided with the air inlet notch 28. An upper end portion of the short tube 26' projects into the reservoir 20 and to this there is fixed a long tube 26", the short tube 26' and long tube 26" together constituting the whole of the tube 26 of the apparatus.

An optional adjustment collar 44 is disposed on the lower end portion of the short tube 26' in some arrangements of this embodiment. The adjustment collar 44 has a first portion 46 of generally cylindrical cross-section which surrounds and is a close fit on the short tube 26'. The first portion varies in axial length circumferentially around the short tube 26'. At its longest part, the first portion 46 extends between the base 22 and the end of the short tube 26' while at its shortest it extends from the base 22 approximately one fifth of the distance to the said end. The axial length of the first portion 46 varies smoothly between its minimum and maximum. The adjustment collar also comprises a lever 48, projecting radially from the first portion 46.

The adjustment collar 44 serves to vary the effective height of the notch 28. Rotation of the collar such that a short part of its first portion 46 overlies the notch 28 causes most of the notch 28 to be revealed while rotation of the collar 44 such that a long part of its first portion 46 overlies the notch 28 reduces the exposed length of the notch 28. Reduction

of the exposed length of the notch 28 results in the notch being more readily sealed by water in the mat, with the effect of reducing the amount of water supplied to the mat and to the growing medium 12. Rotation of the collar 44 may be effected manually by means of the lever 48.

With reference to Figures 4A and 4B, an alternative embodiment of the invention comprises a watering cartridge 100 and a plant pot 102 adapted to receive the cartridge 100.

The construction and operation of the cartridge 100 are fundamentally similar to the construction of the apparatus of the first embodiment.

The cartridge 100 comprises a tubular body 104 which has an open end into which a sealing bung 106 may be removably inserted and a closed end closed by a base 108. A tube 110 passes through an aperture in the base 108, the tube 110 extending from close to the open end of the body 104 to project a short distance from the base 108. A fluid-tight seal exists between the external surface of the tube and the aperture. A small aperture 112 also passes through the base 108.

An absorbent capillary plug 115 is inserted into the bottom end of the tube 110 to project downwardly from the tube.

The plant pot 102 comprises a container 116 for growing medium 118 for supporting a plant 120. Within the container 116 there is a partition 122 which forms between itself and a wall of the container a space 124 which is free from growing medium. The space 124 is shaped and dimensioned such that the cartridge 110 may,

at least partially, be inserted therein. A portion of capillary mat 114 positioned in the bottom of the space 124 extends under the portion 122 and into contact with the growing medium 118.

In use, the bung 106 of the cartridge 100 is removed, the cartridge 100 is filled with water, and the bung is re-inserted. The cartridge 100 is then inserted into the space 124 in the flower pot such that the plug 115 makes contact with the mat 114 at the lower boundary of the space 124. The growing medium 118 is then supplied with water by the mat 114, water being supplied to the mat from the tube 110 and through the aperture 112, in cycles as described in relation to the first embodiment.

As an alternative, it may be possible to use a layer of compost, instead of the capillary mat 114, to transport water between the cartridge and the growing medium.

With reference to Figure 5, an alternative cartridge 130 for use with the pot 102 of Figure 4B dispenses with the need for a sealing bung. [Figure 5 is a side view, the body being of transparent plastics material, the internal components of the cartridge 130 being visible therethrough.]

As with the cartridge 100 described above, the cartridge 130 of the present embodiment comprises a body 132 having an open end, a base 134, tube 136, capillary plug 138 and aperture 139 in the base.

The interior of the body 132 is divided into upper, middle and lower chambers 140, 142, 144 by upper and lower transverse membranes 146, 148. The tube 136

passes through and is sealed to the lower membrane 148, while the upper membrane 146 is spaced closely to the upper end of the tube 136.

The cartridge 130 further comprises an intake tube 150. The intake tube 150 has an upper end which opens into the upper chamber 140, through the upper membrane 146 to which it is sealed. From there, the intake tube 150 extends through the middle chamber 142, and through the lower membrane 148, to which it is also sealed, into the lower chamber 144. Within the lower chamber 144, the intake tube follows a U-shaped path to pass again through the lower membrane 148 and to project a short distance into the middle chamber 142.

An air escape tube 152 extends from within the middle chamber 142 at a level just lower than the upper membrane 146 to within the lower chamber 144 at a level just above the base 134.

Within the lower chamber 144 there is disposed a divider 156 which projects from the base part-way towards the lower membrane 148 to define a water collecting trough into which the air escape tube 152 is received.

A pressure-equalisation hole 158 extends from the lower chamber 144 to the surrounding atmosphere. An aperture 143 passes through the lower membrane 148 between the lower and middle chambers 144, 142, such that water draining therethrough collects in the water collecting trough.

In use, water is poured into the upper chamber 140 from where it drains through the intake tube 150. The water is fed into the middle chamber 142, displacing

air therefrom through the air escape tube 152. Water from the middle chamber 142 drains through the aperture 143 in the lower membrane 148 into the lower chamber 144.

Water may continue to pass through the intake tube 150 until such time as the water collected in the lower chamber 144 reaches such a level as to spill over the divider 156. The collected water seals the lower end of the air-escape tube 152 from the air in the lower chamber. Water within the lowermost part of the intake tube 150 seals the middle chamber from the atmosphere so allowing the system of the middle chamber 142, the tube 136 and the apertures 143 and 139 to deliver water in cycles. Water in the middle chamber 142 may be replenished by simply adding water to the upper chamber 140 as required.

With reference to Figure 6, a propagator embodying the invention comprises a housing 50 in which the reservoir 20 and the base unit 30 are contained. The housing 50 allows open access to a portion of the mat 32 from above, remote from the reservoir 20. A plant container 52 is placed on the open portion of the mat 32. The plant container 52 has a lower part 56 in which the growing medium and plants are contained, and an upper part 58 disposed to cover the lower part 56 and made of transparent material to allow light to fall onto the plants. The base of the lower part 56 of the plant container 52 has apertures through which growing medium within the lower part 56 may come into contact with the mat 32 to absorb water therefrom.

Standard plant pots may alternatively be placed for watering on the mat of the above embodiment.

In the embodiment of Figure 7, the mat 32 is of considerable length to accommodate a large number of plant pots 58'. In substitution for the aperture 24, water is conducted from the reservoir 20 through a pipe 25 to be deposited on the mat 32 remote from the reservoir 20. An additional reservoir 20' may be provided, sealingly connected to the reservoir 20 and having a water delivery tube 21 extending thereinto, to extend the period for which the apparatus may be left between re-fillings.

Figure 8 shows a further embodiment of the apparatus, once again comprising a reservoir 320, an air inlet tube 326, a water outlet aperture 324 and a capillary plug 332, similar to the construction shown in Figure 1. However, in this example the tube 326 extends only a short distance into the reservoir. There is a wall 301 across the top-most end of the tube in which there is a small diameter tube 327 extending a short distance from the top of tube 326. A cap 328 covers the tube 327 such that an air gap exists between tube 327, top of tube 326 and the inside of cap 328. An air release hole 329 placed on the bottom side of cap 328 controls the water released from the system via aperture 324. The size of the hole 329 can be varied to obtain a suitable response rate by rotating cap 328 relative to a gate 330 placed on the top edge of tube 326. The method of operation of this device is similar to that of the first embodiment. This device could be incorporated into a pot as disclosed in Figures 4a,4b or into systems as disclosed in Figures 6 and 7.

In order not to disturb the root structure of established plants, Figure 9 shows a probe consisting of a delivery tube 401 containing an absorbent

material 402 and suction tube 403 with a capillary plug 404 which is inserted into the compost 405 at root level in a container 406.

A cap 407 is designed with tube connectors 408 for ease of inserting the probe system. When in use water mixed with plant food is poured into the chamber 409 by removing cap 407, which is replaced and tightly secured. The absorbent material 402 pulls water from chamber 409 and draws it over into the compost at the deliver end of tube 401. A protector cap 410 with a drip hole prevents compost from coming in direct contact with the absorbent material. The water dripping into the compost comes in contact with capillary plug 404 and is sucked back up suction tube 402 via air hole 411. The method of operation of this device is similar to that of the first embodiment.

CLAIMS

1. A self-regulating system, for watering a plant growing in a growing medium, in which water-supplying means comprising a reservoir is arranged to deliver water to the growing medium under the control of controlling means which is responsive to the wetness of the growing medium, the controlling means being arranged to regulate the dispensing of water from the reservoir by controlling the admission of pressure-balancing air into the reservoir through the use of an air inlet which is arranged to become sealed in a wet condition of the medium.

2. Self-regulating apparatus for watering a plant growing in a growing medium comprising water-supplying means arranged to supply water to a water outlet, water-transporting means arranged to receive water supplied from the water outlet and to extend into contact with the growing medium, whereby water can be taken up from the transporting means by absorption by the growing medium, and controlling means which is responsive to the amount of water present in the transporting means to regulate the dispensing of water through the water outlet.

3. Apparatus according to claim 2 in which the water-supplying means comprises a reservoir and the controlling means is arranged to regulate the dispensing of water through the water outlet by controlling the admission of pressure-balancing air into the reservoir.

4. Apparatus according to claim 3 in which the controlling means comprises means forming an air inlet

which is arranged to become sealed by water collecting in the transporting means.

5. Apparatus according to claim 4 in which the water-transporting means comprises water-absorbent material against which the air inlet becomes sealed in a wet condition of the material, balancing air being permitted to enter the reservoir through the inlet in a drier condition of the material.

6. Apparatus according to claim 5 in which the air inlet is provided by an opening formed between a bottom end portion of an inlet duct and the material, the duct leading into the reservoir and sealing at its bottom end against the material in the wet condition of the material.

7. Apparatus according to claim 6 in which the duct communicates with the interior of the reservoir at a level above the normal level of water within the reservoir.

8. Apparatus according to either of claims 6 and 7 in which the inlet duct is in the form of an upright tube which extends upwards from the material and through a base of the reservoir into the interior of the reservoir.

9. Apparatus according to any one of claims 6, 7 and 8 in which the air inlet opening is in the form of a notch which extends from a generally annular end face of the duct which abuts the material.

10. Apparatus according to any one of claims 5 to 9 in which the water-absorbent material extends without

interruption from a position adjacent to the water outlet into contact with the growing medium.

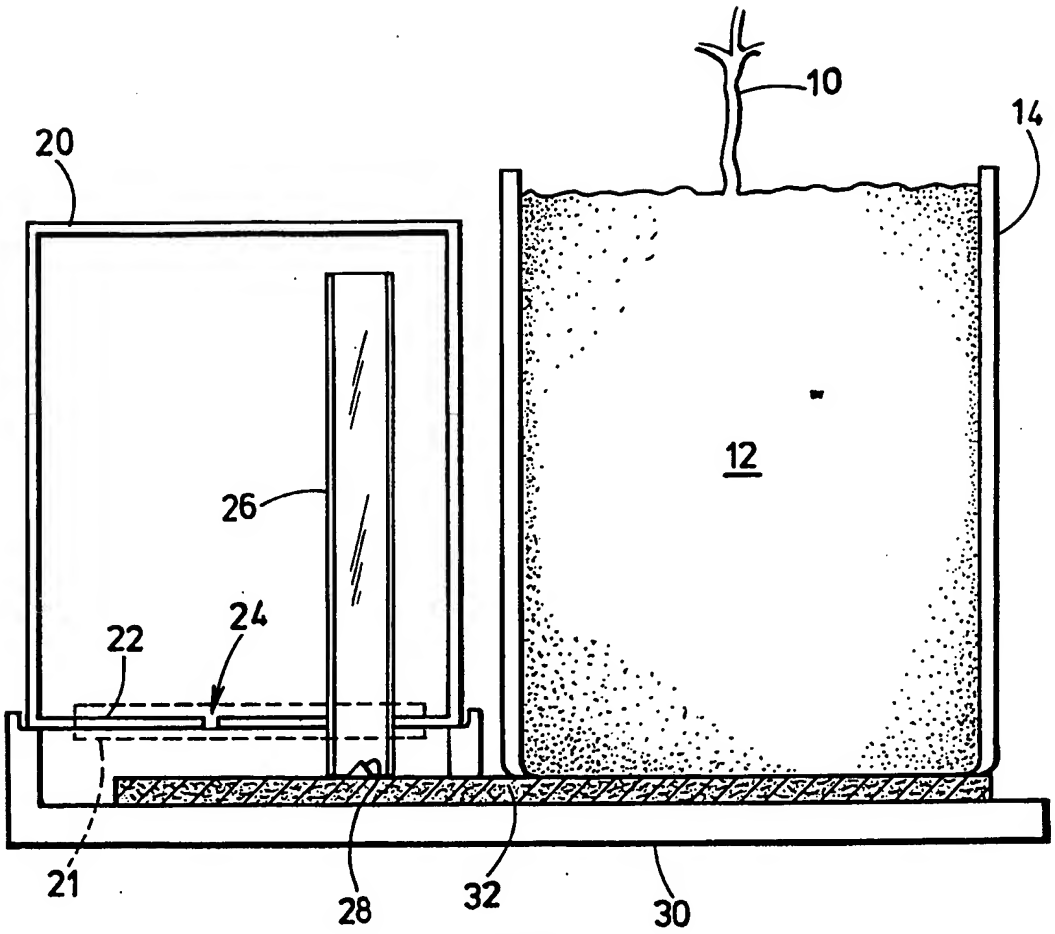

FIG.1

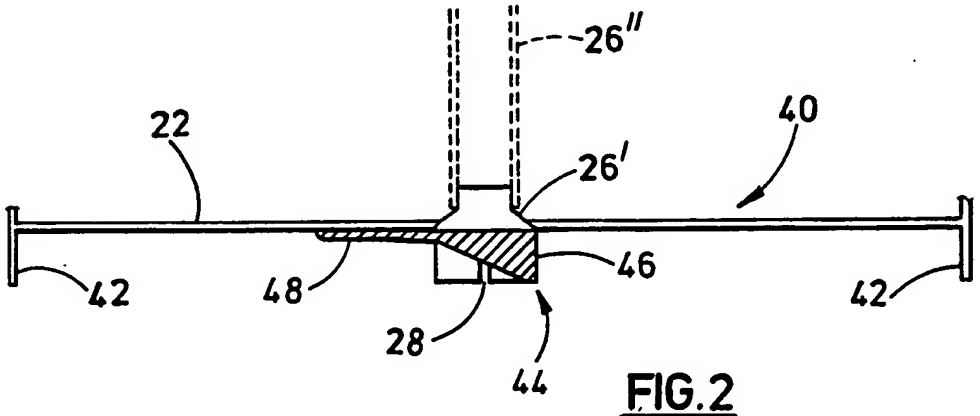

FIG.2

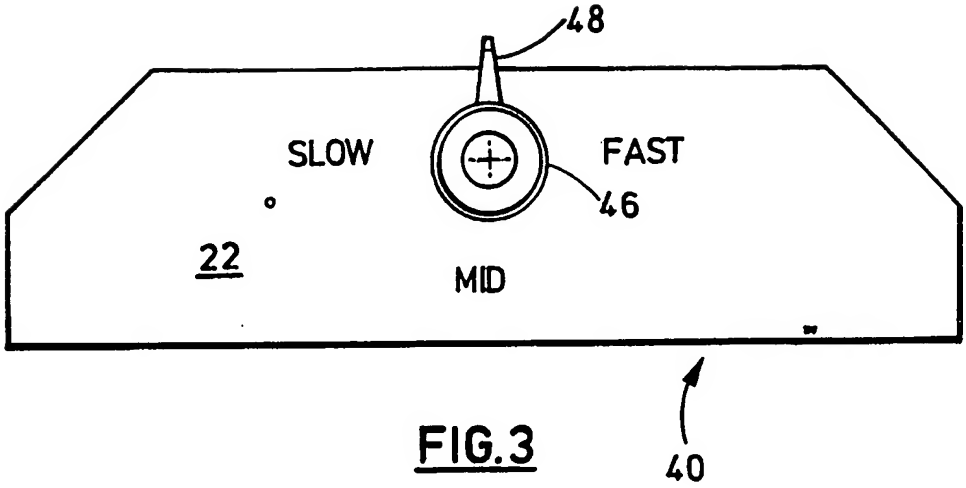

FIG.3

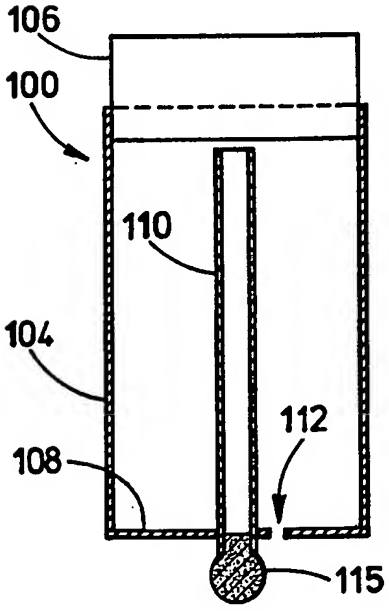

FIG.4A

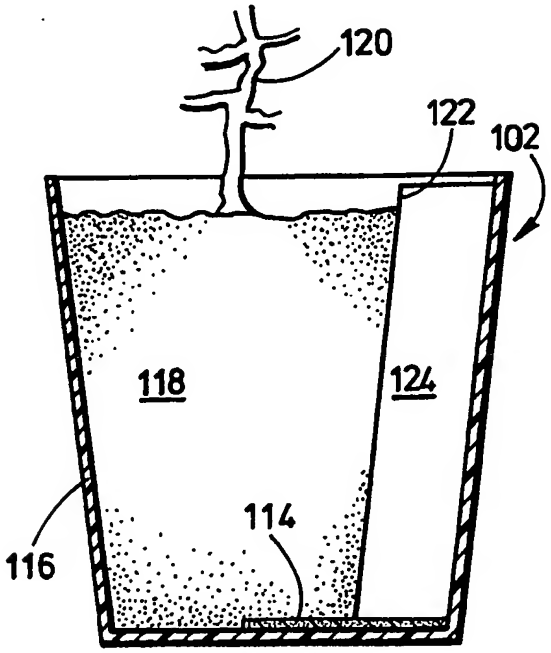

FIG.4B

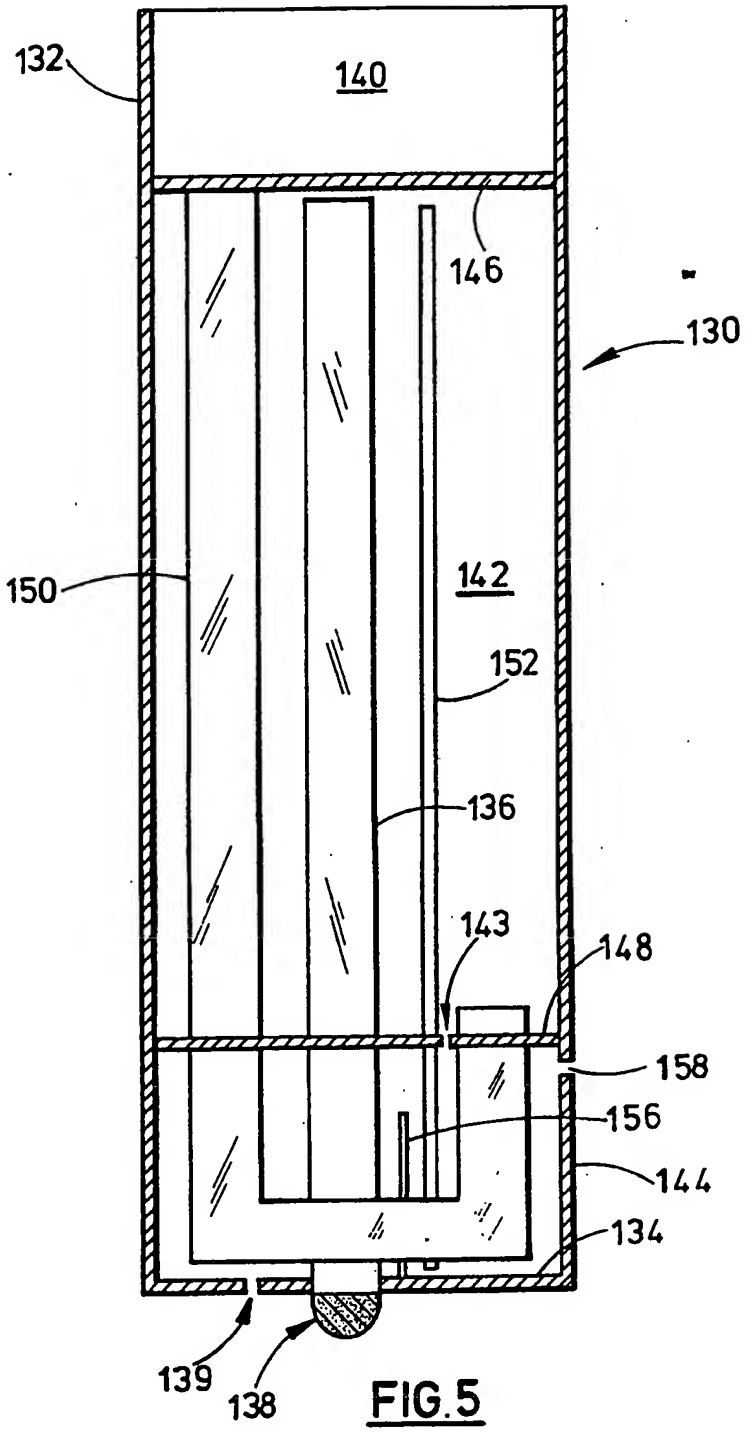

FIG.5

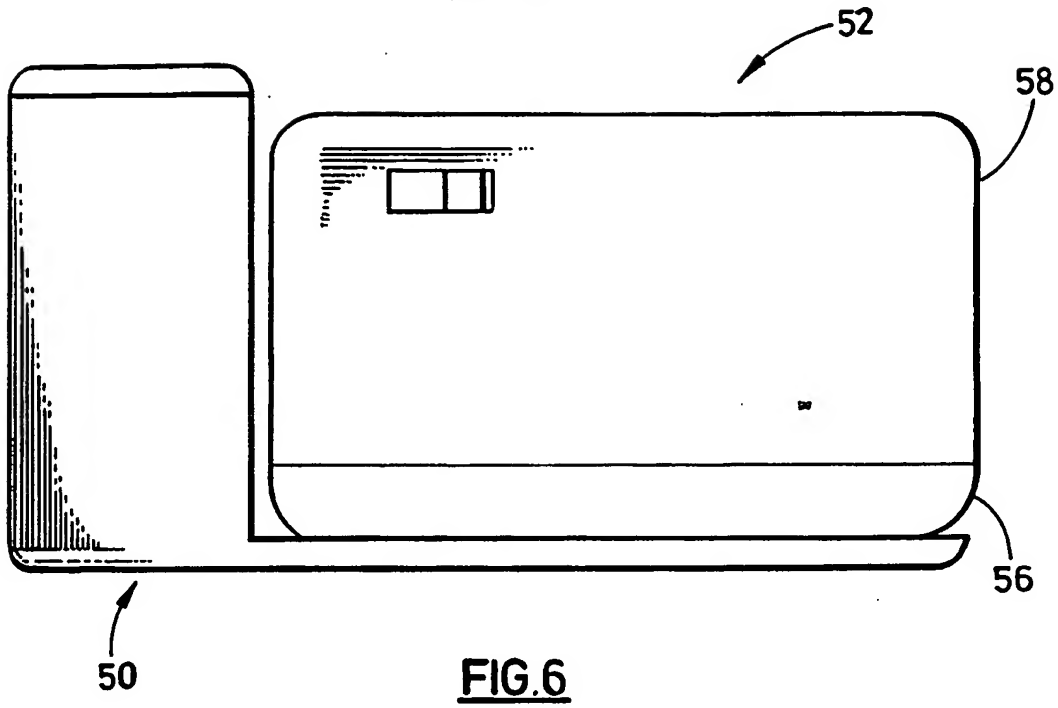

FIG.6

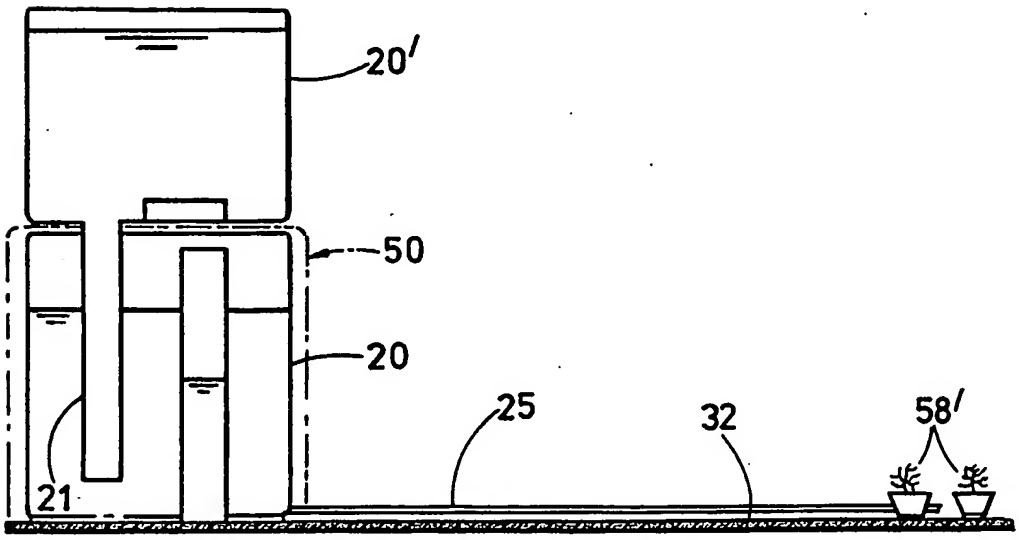

FIG.7

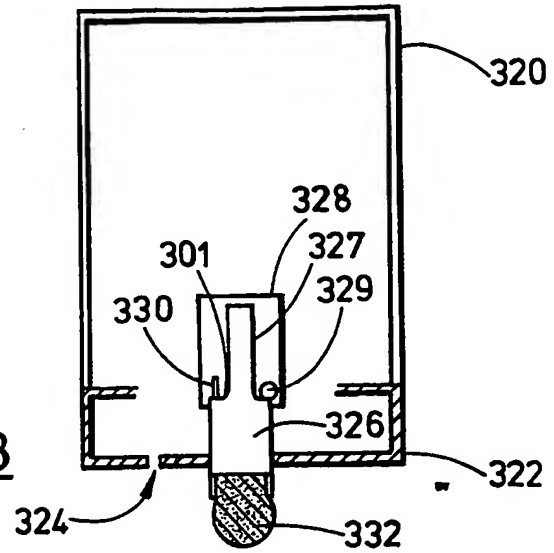
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FIG.8

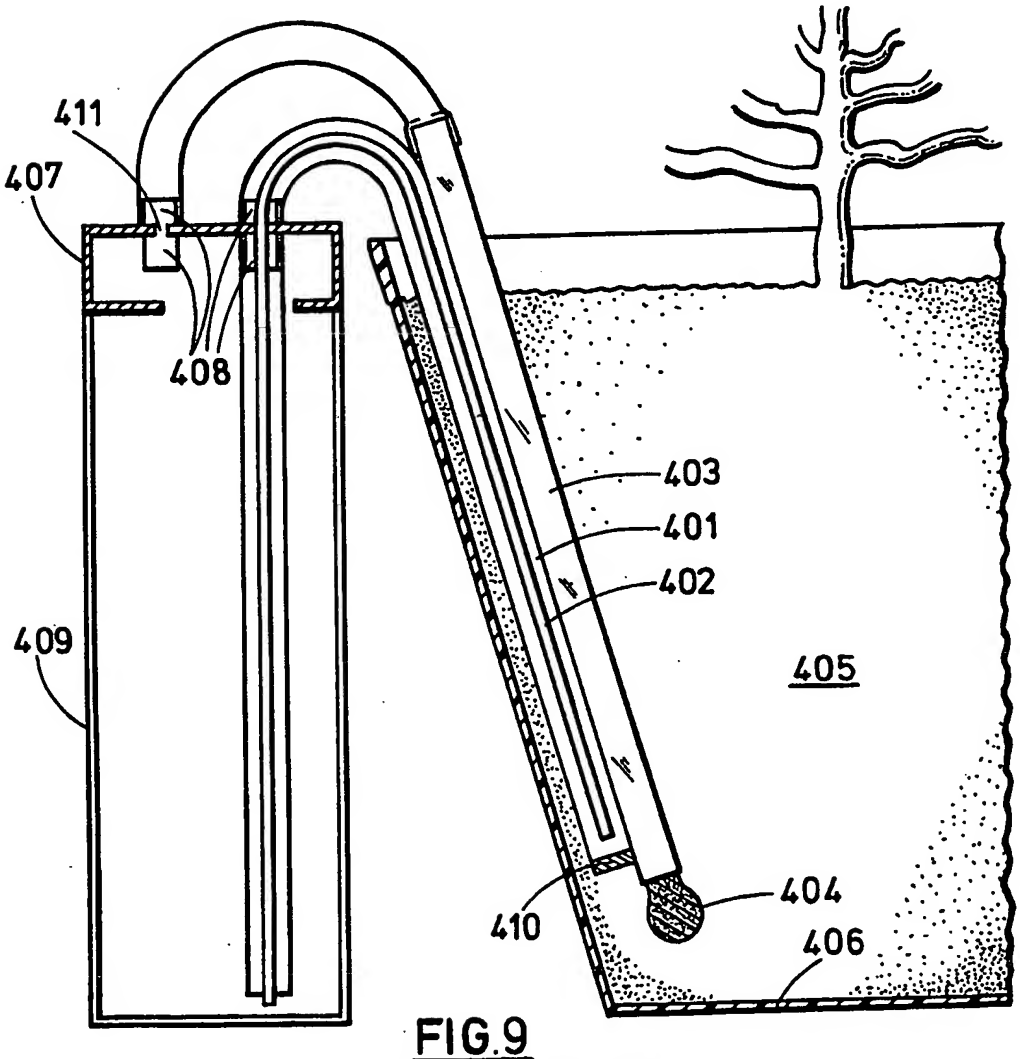
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FIG.9

INTERNATIONAL SEARCH REPORT

International application No.
GB 94/02307

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A01G27/00 A01G27/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR,A,2 554 314 (CHAUDOUET) 10 May 1985 see page 1, line 22 - page 2, line 5; figure 1	1-3
X	US,A,4 819 375 (BAUMGARTNER) 11 April 1989 see the whole document	1-3
X	US,A,3 438 575 (ROHLING) 15 April 1969 see column 3, line 71 - column 6, line 40; figures 1-9	1
X	US,A,5 046 282 (WHITAKER) 10 September 1991 see column 4, line 26 - column 5, line 32; figures 1-3	1

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9 January 1995	06. 02. 95

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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